Staff Paper P95-2 January, 1995

STAFF PAPER SERIES

PLANETOR: THE POTENTIAL TO ADAPT IT FOR ITALY

by

Antonio Boggia and Kevin S. Klair

DEPARTMENT OF AGRICULTURAL AND APPLIED ECONOMICS
COLLEGE OF AGRICULTURE
UNIVERSITY OF MINNESOTA

Staff Paper P95-2 January, 1995

PLANETOR: THE POTENTIAL TO ADAPT IT FOR ITALY

by

Antonio Boggia and Kevin S. Klair *

* Antonio Boggia is From the Institute of Estimo rurale e Contabilita` of the University of Perugia, Italy. Kevin S. Klair is an Assistant Extension Economist with the Center for Farm Financial Management, Department of Agricultural and Applied Economics, Minnesota Extension Service, University of Minnesota.

PLANETOR : THE POTENTIAL TO ADAPT IT FOR ITALY

1. Introduction

This paper will discuss some of the results from the study period of Antonio Boggia, from the Institute of Estimo rurale e Contabilita` of the University of Perugia (Italy) at the Center for Farm Financial Management, Department of Agricultural and Applied Economics, University of Minnesota. The two main objectives of this visit were:

1) to study state of the art of sustainable agriculture applications in the U.S., with particular respect to the economic impact of sustainable agriculture on farms, and the linkage with farm management;

2) to study Planetor, a computer program that the Center for Farm Financial Management is working on, to try to use it with Italian farm data, and to test if and how it would be possible to develop an Italian version of the program.

The results of this second purpose will be presented in this paper.

Three different applications of Italian data were evaluated with Planetor, resulting in the analyses of three different kinds of Italian farms. These three Italian farms in the Tiber River watershed are typical of central Italy, in a situation where adequate water is available and very low slopes dominate. This is one of the sample areas in Italy in which the CNR (National Council of Research) is developing the RAISA project. The RAISA project is a national research program, which includes several studies in the field of agricultural science. The Institute of Estimo rurale e Contabilita` of the

University of Perugia is one of the institutions involved in this research project. In the case of the Tiber River watershed, the research is focused on the environmental impact assessment of agricultural production and on the introduction of environmentally sound farm management. In other words, the main purpose is the introduction of sustainable agricultural systems.

2. Sustainable Agriculture and Computer Science

The Brundtland Report (WCED, 1987) defines Sustainable Development as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs...". This is a very complex way to define development because sustainable development is aimed simultaneously toward economic, social and environmental goals. All different sectors of development can and should be involved in this strategy. Agriculture, of course, is very much involved in the sustainability concept because it implies the use of natural resources. One of the most important rules to achieve sustainability is to give priority to natural capital stock rather than to the flow of income it could make possible. This concept is emphasized in another definition of sustainable development: "Sustainable economic development involves maximizing the net benefits of economic development, subject to maintaining the services and quality of natural resources over time" (D. Pearce et al., 1988). From this point of view the agricultural mission is not only food production, like in the past, but also the saving of natural capital stock. In other words, the bringing together of conservation and production results in sustainable agriculture. "The goal of a sustainable agriculture should be to maintain production at levels necessary to meet the increasing aspirations of an expanding world population without degrading the environment. It implies concern for the generation of income, the promotion of appropriate policies, and the conservation of natural resources"

(TAC/CGIAR, 1989).

How is it possible to determine if an agricultural system is really sustainable? At what point does philosophy end and science begin? It is very difficult to answer this question. Vernon W. Ruttan, in closing his paper "Sustainable Growth in Agricultural Production: Poetry, Policy and Science" asserts: "At present, there is no package of technology available to transfer to producers that can assure the sustainability of growth in agricultural production at a rate that will enable agriculture, particularly in the developing countries, to meet the demands being placed on them. At present, sustainability is appropriately viewed as a guide to future agricultural research agendas rather than as a guide to practice" (V.W.Ruttan, 1991). What Ruttan sees is an uncertain future for sustainable agriculture. One of the most important weaknesses of sustainable development at present is that it is not possible to measure the level of sustainability achieved by a certain activity. The environmental economists are trying to accomplish this objective but, even if it is possible to find very good theoretical explanations of the sustainable economic system such as in "Economics of Natural Resources and the Environment" by D.W.Pearce and R.K.Turner, there is a lack of knowledge about which environmental concerns should be incorporated in the economic calculations. This means that it is not possible, at least at present, to include in the balance sheet of a farm the environmental impacts, both positive and negative, in monetary terms. But to be fully included in the agricultural science, sustainable agriculture needs to be measured. This step should not be delayed any longer, especially since in some parts of the world subsidies are given to farmers for sustainable production. There is a need to evaluate the level of sustainability to understand whether or not a farm is eligible for such a subsidy.

In the U.S., the Sustainable Agriculture Research and Education Program (SARE), initiated in 1988 under the name of Low Input Sustainable Agriculture Program (LISA), funds different kind of research and education projects both at regional and national levels to enhance the quality of sustainable agriculture. This program also gives grants to farmers to test innovations and share what they have learned.

The European Union in 1992 issued a Regulation (2078/92) in which subsidies are provided for farmers who implement one or more of a list of commitments basically oriented towards a sustainable agriculture, such as a reduction in the use of fertilizers and pesticides, the introduction of organic farming methods, or a reduction in the intensity of livestock breeding. Also included on this list is the management of land for public access and recreational activities to create a better linkage between agriculture and natural resources. Another Regulation (2080/92) provides financial aid to farmers who will introduce forests on tillable land on their farms. This offers a very interesting alternative to traditional agricultural production, and provides the opportunity to introduce agroforestry systems in European countries. Agroforestry as a multiple land-use system is a good way to achieve soil conservation, prevention of erosion and siltation, and ecological benefits for other crops and animals (biodiversity), etc. Agroforestry has the potential of addressing a wide range of needs with a low level of external inputs and on a sustainable basis.

Both the SARE program in the USA and the Regulations in the EU, are examples of reasons to develop a measurement of sustainability. Assuming sustainability means to achieve both economic and social-environmentally sound results, to evaluate sustainable agriculture we need to simultaneously monitor the economic and environmental impacts of farms' activities. "The research agenda on sustainable agriculture needs to define what is biologically feasible without being excessively limited by present economic constraints" (V.W.Ruttan, 1991). If we cannot achieve the goal of including environmental impacts in the economic balance, the one thing we can do is to measure economic and environmental results separately. On one hand, from the economic point of view, it is possible to use the traditional balance sheet; on the other hand there is a need to identify appropriate parameters and indicators for the environmental impact. This means that many different aspects of a farm's activity and of the environment in which a farm is located have to be managed at the same time. Computer science can be very helpful at this stage. In fact, dealing with environmental assessment necessitates managing large amounts of data and different kinds of information. Site specific climate and soils have to be processed together with the farm operations, chemical use, etc. to get output concerning the impact of farming operations on the environment.

For this reason, computer science is valuable and essential for evaluating sustainable agriculture. Planetor does evaluate sustainable agriculture. Planetor is a computer program that integrates the economic and environmental assessment of farms and is able to give separate economic and environmental output. One of the most relevant features of Planetor is that one program includes several different models for the assessment of both economic and ecological parameters. In fact, other programs use some ecological or economic models but use them separately. For example, it is possible to find software for the soil erosion calculation on the market, but only for that; or software for pesticides leaching, but only for that; and so on. Planetor uniquely puts together different kinds of ecological models, together with an economic analysis. As a result, it is a whole farm financial and environmental management tool. In other words, it provides appropriate methodology for measuring sustainability in agriculture.

3. Description of the Planetor Program

Planetor is a computer program designed to help farmers evaluate the impacts of implementing sustainable farming practices. The current version of Planetor is Planetor 2 which is a revision of the original version 1. Planetor will allow farmers to evaluate the environmental and economic consequences of reducing or changing pesticide applications, nitrogen and phosphorus applications, tillage systems, and crop rotations.

The program will project the potential soil erosion, pesticide leaching, runoff and toxicity, nitrogen leaching, and phosphorus runoff associated with the current farm operation. It will then allow a farmer to evaluate the environmental impact of alternative farming practices while simultaneously projecting the economic impact of the changes. Including the economic analysis enhances the effectiveness of Planetor by allowing farmers to implement environmentally sound production practices without having to guess how the changes will effect them financially.

Planetor is a whole farm long range planning tool. It can evaluate crop rotations of up to 10 years in length. It evaluates the environmental factors for each field on the farm and projects a long range economic analysis for the whole farm business. Planetor is designed to help farmers better understand the current environmental impacts of their farming practices and evaluate alternative practices from both an environmental and an economic perspective.

Planetor is a multiple objective program that evaluates a number of environmental and economic factors with a single user interface. Most of the environmental models used in Planetor were developed as single objective models by researchers at other universities, with the Agricultural Research Service (ARS) or the Soil Conservation Service (SCS).

3.1 Planetor Output

To evaluate the potential for adverse environmental effects Planetor uses a system of high, medium, and low ratings as displayed in Figure 1. The potential for high, medium, or low problems are evaluated for soil water erosion, pesticide leaching, runoff and toxicity, nitrogen leaching, and phosphorus runoff for each field on the farm. These ratings reflect the potential impacts over the entire duration of the crop rotation.

File: SAMPLE Environmental Output

more →

Field	Acres	Water Erosion	Pesticide Leaching	Pesticide Runoff	Nitrogen Leaching	Phos. Runoff
Home- E. upper strip	19	(▶L◀)	▶H◀	▶M◀	▶M◀	▶L◀
Home-E. lower strip	22	▶L◀	▶H◀	▶M◀	▶L◀	▶L◀
Home-behind barn	10	▶L◀	▶M◀	▶M◀	▶L◀	▶H◀
Home - West strip	27	▶L◀	▶M◀	▶M◀	▶L◀	▶L◀
Home - north	43	▶L◀	▶H◀	▶H◀	▶H◀	▶H◀
Home - west	31	▶L◀	▶H◀	▶H◀	▶L◀	▶M◀
Johnson's - south	33	▶L◀	▶H◀	▶H◀	▶H◀	▶L◀
Johnson's - north	51	▶L◀	▶H◀	▶H◀	▶M◀	▶L◀
Pasture	42	▶L◀	▶M◀	▶L◀	▶L◀	▶M◀
Pasture	44	▶L◀	▶M◀	▶L◀	▶L◀	▶L◀

Net farm income 53311

F1 Help F3 Detail F10 Menu

Figure 1: Planetor environmental output

In addition to the high, medium, and low ratings, each environmental factor has additional detailed information available. Although the format for this additional information varies for the individual environmental factors, in general, it includes the key component indices calculated for each factor and displays the results for individual years within the rotation. Figure 2 illustrates the additional information available for soil water erosion.

Water Erosion Estimate -- home - West strip

Climate erosivity (R)		130
Soil erodibility (K)	*	0.37
Slope length & steepness (LS)	*	1.41
Coverage (C)	*	0.08
Practice (P)	*	0.82
Avg. annual soil erosion (A)	=	4.6 tons ▶M◀
Tolerable annual erosion (T)		4.0 tons
Avg. annual excess		0.6 tons

	Annual Coverage	Annual Erosion	Annual Excess
Yr 1 Corn	0.07	3.9	0.0
Yr 2 Corn	0.21	11.7	7.7
Yr 3 Soybeans	0.22	12.3	8.3

more ↓

Figure 2: Detailed environmental output

The economic output generated by Planetor is essentially the same long range output calculated by the long range planning component of FINPACK, a farm financial planning program widely used in the U.S. This output includes an average annual income statement, cash flow, and solvency section. In addition, feed balances are calculated for each year based on the crop rotation and the livestock numbers entered into the plan.

3.2 Models Used to Evaluate the Environmental Factors

Soil Water Erosion

The Revised Universal Soil Loss Equation (RUSLE) is incorporated into Planetor to estimate soil losses due to rainfall and surface runoff. RUSLE was primarily developed by ARS with considerable support from SCS.

The RUSLE equation is A = R K L S C P

where A = average annual soil loss from sheet and rill erosion caused by rainfall and its associated overland flow
R = the factor for climatic erosivity
K = the factor for soil erodibility measured under a standard condition
L = the factor for slope length
S = the factor for slope steepness
C = the factor for cover/management
P = the factor for support practices

These factors represent the effect of climate, soil, topography, and land use on sheet and rill erosion. Using values based on site specific conditions RUSLE can compute soil losses for specific sites and can be used as a guide for conservation planning for individual fields . RUSLE, and therefore Planetor, use a two week time step to calculate the C factor based on climatic and crop growth data stored in the accompanying databases.

Nitrogen Leaching

Planetor uses the Nitrogen Leaching and Economic Analysis Package (NLEAP) to project potential nitrogen leaching. NLEAP was developed by ARS to implement the theories of nitrogen movement into a user oriented program that would be available to farmers and professionals who work with them (Shaffer, et. al. 1991). Based on site specific field conditions NLEAP calculates nitrogen budgets, projects the potential nitrate-N available for leaching, and then utilizing a water movement model projects the amount of nitrate-N leached. Planetor has incorporated the monthly time step calculations from NLEAP.

Phosphorus Runoff

Potential phosphorus runoff is estimated in Planetor using the Phosphorus Index developed by a National SCS Phosphorus Task Force (Lemunyon, 1993). The purpose of the Phosphorus Index is to provide a tool to assess the potential risk of phosphorus movement to water bodies based on site specific characteristics and management practices. The Phosphorus Index uses parameters that can have an influence on phosphorus availability, retention, uptake, and movement. These parameters include the soil erosion rate, soil runoff class determined from the soil permeability class and the slope percent, available phosphorus from soil tests, phosphorus fertilizer applications rates and methods, and organic phosphorus application rates and methods.

Pesticide Leaching and Runoff

The potential for pesticide leaching and runoff in Planetor is evaluated using a screening level methodology developed to evaluate pesticide-soil interactions (Hornsby, 1992). This procedure gives a relative index of the potential for leaching or runoff problems based on the pesticide chemical properties, soil properties, and the application rate. Climatic factors are not included in this screening procedure.

Pesticide Toxicity

The pesticide label rating (danger/poison, danger, warning, caution) for applicator hazard pesticide toxicity based on label information is part of the output in Planetor.

Manure Management

Planetor calculates the total manure generated by a livestock enterprise. Nitrogen losses from storage systems, application methods, and application timing are included to estimate the actual nitrogen available from manure. The manure management portion of Planetor interacts with both the nitrogen leaching and the phosphorus runoff parts of the program. Planetor can also evaluate the estimated losses of nutrients based on pasture application of manure associated with intensive grazing.

3.3 Databases

Planetor relies very heavily on databases to reduce the data input required from users. The primary databases included in Planetor are Soils, Pesticides, Climate, Crops, and Machinery Operations. There are also a number of smaller databases including Fertilizer, Manure, Livestock, Irrigation, and Tax information stored in Planetor. The appendix contains a detailed list of the database items required to use Planetor.

The soils database contains the soil data elements required to run RUSLE, NLEAP, the pesticide/soil screening procedure, and the phosphorus index. This database was developed in cooperation with SCS and is maintained through a direct Internet interface with the national SCS soils database.

The Planetor pesticide database utilizes the chemical properties data from the database developed by Wauchope and Hornsby, 1992. Additional data required concerning pesticide label information was obtained from the Crop Protection Chemicals Reference, 1994.

Two climate databases are maintained in Planetor, one developed by ARS for use with RUSLE and the other developed by ARS for use with NLEAP. Both of these databases contain an average of 3 to 4 sites per state. Additional sites are included in states that have greater variations in weather, such as mountainous states.

Data for the crops database was obtained from three sources, the regional RUSLE crop databases developed by SCS, the NLEAP regional crop databases developed by ARS, and general crop and economic data incorporated by the Center for Farm Financial Management.

The Planetor machinery operations database is the combination of the RUSLE machinery operations database developed by ARS and SCS and economic data developed at the University of

Minnesota (Fuller, et. al. 1992)

4. Using Planetor to Evaluate Sustainability of Three Italian Farms

The Italian case farms developed for the application are representative of farms located in the Trasimeno Lake area. Trasimeno Lake is the largest lake of Central and Southern Italy, and is part of the Tiber river watershed. Figure 3 presents an overview of the three farms.

FARMS	ACREAGE	CROPS	LIVESTOCK
FARM 1 (Azienda agraria Trasimeno 1)	60	Corn	Hogs, finish feeder pigs 250 head
FARM 2 (Azienda agraria Trasimeno 2)	200	Cantaloupe Peppers bell	Hogs, finish feeder pigs 400 head
FARM 3 (Azienda agraria Trasimeno 3)	200	Corn Barley Sunflowers	---

Figure 3: Overview of the farms

All the three farms are conventional farms, which means they don't use alternative or organic agricultural production techniques. This is because most of the farms in the Trasimeno area are conventional. As a result of the previously described European Union regulation 2078/92, next year many farms are expected to use alternative production techniques, but currently such data is not available.

4.1. Farm 1 (Azienda agraria Trasimeno 1)

Farm 1, named Azienda agraria Trasimeno 1, is a very common case of a continuous corn cropping system. This farm also has a swine production enterprise, finishing 250 feeder pigs per year. Usually farmers in the Trasimeno area use corn for hog feeding only in small scale livestock operations, for instance 40-50 feeder pigs. In large scale hog production the use of purchased mixed feeds is very common with the corn produced on the farm being sold. Corn is still a high income crop in Italy, so most farmers prefer to sell it rather than use it for animal feed. Of course each case may be different, and this kind of decision comes from a comparative calculation.

Corn is one of the most important crops in Central Italy. In the Trasimeno area several farms grow continuous corn as their crop rotation for up to ten years. In this case, Farm 1 grows corn on its entire 60 acres, and it will do so for at least the next three years. Conventional tillage, sprinkler irrigation, manure application, and high chemical inputs are used to achieve an average yield of 160 bushels per acre. The average price per bushel of corn is $4.68. This results in a return over direct expenses of $ 350.30 per acre. Figure 4 shows the main input technologies used.

CROP	**TILLAGE**	**PESTICIDE**	**FERTILIZER**	**IRRIGATION**
Corn	Conventional	Lasso MCPA	Urea Ammonium Phosphate Potassium Sulfate Swine manure	Sprinklers

Figure 4: Main input technologies for Farm 1.

Regarding the livestock enterprise, the pigs are sold when they weigh 330 lbs at an expected price of $80.00/cwt. All livestock feed is purchased. The return over direct expenses is $43.82 per head. The manure storage system is an earth storage basin. All the manure is distributed on the farm fields.

Figure 5 lists the main characteristics of each of the four fields on the farm.

A quick look at the outputs, both economic and environmental, shows that from the economic point of view the farm produces positive results. Conversely, the environmental outputs seem to be very negative. Only two fields have a low water erosion potential and medium phosphorus runoff potential. The rest of the indicators show a high potential environmental risk; which means that, even if the farm is good from the economic point of view, it is very far from the concept of sustainability. In fact good economic results are not enough when potential environmental impacts are so high. Figure 6 shows the field, environmental and economic summary.

AZIENDA AGRARIA TRASIMENO 1

FIELD NO. 1

Name APPEZZAMENTO 1
Acres 15
Soil Type Millsholm Rocky sandy loam, 0% slope
Org. matter 0.75
pH 6.45
Practice Other

Crop Rotation

Year 1	Corn,	120 day,	30" row,	150 bu.,	Conventional,	Irr.
Year 2	Corn,	120 day,	30" row,	150 bu.,	Conventional,	Irr.
Year 3	Corn,	120 day,	30" row,	150 bu.,	Conventional,	Irr.

FIELD NO. 2

Name APPEZZAMENTO 2
Acres 15
Soil Type Millsholm Rocky sandy loam, 5-30% slope
Org. matter 0.75
pH 6.45
Practice Other

Crop Rotation

Year 1	Corn,	120 day,	30" row,	150 bu.,	Conventional,	Irr.
Year 2	Corn,	120 day,	30" row,	150 bu.,	Conventional,	Irr.
Year 3	Corn,	120 day,	30" row,	150 bu.,	Conventional,	Irr.

FIELD NO. 3

Name APPEZZAMENTO 3
Acres 15
Soil Type Millsholm clay loam, 0% slope
Org. matter 2
pH 6.45
Practice Other

Crop Rotation

Year 1	Corn,	120 day,	30" row,	150 bu.,	Conventional,	Irr.
Year 2	Corn,	120 day,	30" row,	150 bu.,	Conventional,	Irr.
Year 3	Corn,	120 day,	30" row,	150 bu.,	Conventional,	Irr.

FIELD NO. 4

Name APPEZZAMENTO 4
Acres 15
Soil Type Millsholm clay loam, 5-30% slope
Org. matter 2
pH 6.45
Practice Other

Crop Rotation

Year 1	Corn,	120 day,	30" row,	150 bu.,	Conventional,	Irr.
Year 2	Corn,	120 day,	30" row,	150 bu.,	Conventional,	Irr.
Year 3	Corn,	120 day,	30" row,	150 bu.,	Conventional,	Irr.

Figure 5: Field Information, Farm 1

AZIENDA AGRARIA TRASIMENO 1

FIELD SUMMARY

Field	Acres	Year 1	Year 2	Year 3
APPEZZAMENTO 1	15	Corn	Corn	Corn
APPEZZAMENTO 2	15	Corn	Corn	Corn
APPEZZAMENTO 3	15	Corn	Corn	Corn
APPEZZAMENTO 4	15	Corn	Corn	Corn

ENVIRONMENTAL SUMMARY

Field	Water Erosion Potential	Pesticide Leaching Potential	Pesticide Runoff Potential	Pesticide Warning Label	Nitrogen Leaching Potential	Phosphorous Runoff Potential	Wind Erosion Potential
APPEZZAMENTO 1	L	HHHHH	HHHHH	HHHHH	-	MMM	-
APPEZZAMENTO 2	HHHHH	HHHHH	HHHHH	HHHHH	-	HHHHH	-
APPEZZAMENTO 3	L	HHHHH	HHHHH	HHHHH	-	MMM	-
APPEZZAMENTO 4	HHHHH	HHHHH	HHHHH	HHHHH	-	HHHHH	-

ECONOMIC SUMMARY

		Average of All Years
ACRES	Crop Acres	60
FINANCIAL	Net farm income	29,339
	Cash surplus or deficit	19,462
	Net worth changed	19,243
FEED BALANCES	Corn equivalents (bu.)	-
	Hay equivalents (ton)	-
	Silage equivalents (ton)	-
	Pasture equiv. (AUM)	-
LABOR	Annual labor hours	2,354
WATER	Inches per irrigated acre	4.3
	Total acre feet	21.5

Figure 6: Plan Summary, Farm 1

4.2. Farm 2 (Azienda agraria Trasimeno 2)

Farm 2, Azienda agraria Trasimeno 2, is another typical farm of the Trasimeno area. It is a vegetable production farm, which is also a high input crop. The most common vegetables grown in that area are cantaloupe, bell peppers, and tomatoes. On this farm cantaloupe and bell peppers are grown. The farm also has one livestock enterprise, finishing 400 feeder pigs. It is well known that vegetable crops are very vulnerable to pest attacks. They are threatened by weeds, insects, fungi, and other pests; so they need very strong pest controls, usually requiring several chemicals. This presents problems from both the environmental and the cost control perspectives. The high costs are balanced with a very high product income, due to the high average sales price.

Farm 2 is 200 acres, half of which is used to produce cantaloupe and the other half for bell peppers. To grow these vegetables, this farm uses conventional tillage, row irrigation, manure application, and several kinds of chemical products. Cantaloupe yield per acre is 200 cwt, with an expected price per cwt of $19.00. Despite the very high direct expense per acre, cantaloupe generates a return over direct expenses of $1528.08 per acre. Bell peppers yield per acre is also 200 cwt per acre, but the expected price is higher, $25.40 per cwt, so the return over direct expenses is also higher at $1771.25 per acre. The main input technologies used for each crop are shown in Figure 7.

CROP	TILLAGE	PESTICIDE	FERTILIZER	IRRIGATION
Cantaloupe	Conventional	Alanap-L Pramitol 25E Captan 80-WP Rubigan EC	Urea Ammonium Phosphate Potassium Sulfate Swine Manure	Row
Peppers bell	Conventional	Balan EC Penncozeb Daconil 2787 Rubigan EC	Ammonium Nitrate Ammonium Polyphosp. Potassium Sulfate Swine manure	Row

Figure 7: Main input technologies for Farm 2.

The pigs are sold when they weigh 330 lbs, at an expected price of $80.00/cwt. All livestock feed is purchased. On this farm the direct livestock labor is very high which has a high impact on the direct expenses, so the return over direct expenses is only $16.22 per head. The manure storage system is an earth storage basin. All the manure is distributed on the farm fields.

Figure 8 lists the main characteristics for each of the six fields on the farm.

The output portrays a worse situation than for Farm 1. Vegetables and swine are a very good combination from the economic point of view, but the environmental results are extremely negative. As a result, Farm 2 has a very high potential for causing environmental problems.

Figure 9 shows the field, environmental, and economic summary for Farm 2.

AZIENDA AGRARIA TRASIMENO 2

	FIELD NO. 1			
Name	APPEZZAMENTO 1			
Acres	50			
Soil Type	Brentwood clay loam			
Org. matter	0.75			
pH	7.5			
Practice	Other			
	Crop Rotation			
Year 1	Cantaloupe,	Meloni pieno campo,	Conventional,	Irr.
Year 2	Peppers Bell,	Peperoni pieno campo,	Conventional,	Irr.
	FIELD NO. 2			
Name	APPEZZAMENTO 2			
Acres	30			
Soil Type	Millsholm Rocky sandy loam, 0% slope			
Org. matter	0.75			
pH	6.45			
Practice	Other			
	Crop Rotation			
Year 1	Cantaloupe,	Meloni pieno campo,	Conventional,	Irr.
Year 2	Peppers Bell,	Peperoni pieno campo,	Conventional,	Irr.
	FIELD NO. 3			
Name	APPEZZAMENTO 3			
Acres	20			
Soil Type	Millsholm clay loam, 5-30% slope			
Org. matter	2			
pH	6.45			
Practice	Other			
	Crop Rotation			
Year 1	Cantaloupe,	Meloni pieno campo,	Conventional,	Irr.
Year 2	Peppers Bell,	Peperoni pieno campo,	Conventional,	Irr.
	FIELD NO. 4			
Name	APPEZZAMENTO 4			
Acres	60			
Soil Type	Millsholm clay loam, 0% slope			
Org. matter	2			
pH	6.45			
Practice	Other			
	Crop Rotation			
Year 1	Peppers Bell,	Peperoni pieno campo,	Conventional,	Irr.
Year 2	Cantaloupe,	Meloni pieno campo,	Conventional,	Irr.
	FIELD NO. 5			
Name	APPEZZAMENTO 5			
Acres	15			
Soil Type	Millsholm Rocky sandy loam, 5-30% slope			
Org. matter	0.75			
pH	6.45			
Practice	Other			
	Crop Rotation			
Year 1	Peppers Bell,	Peperoni pieno campo,	Conventional,	Irr.
Year 2	Cantaloupe,	Meloni pieno campo,	Conventional,	Irr.
	FIELD NO. 6			
Name	APPEZZAMENTO 6			
Acres	25			
Soil Type	Goulding clay loam, 0% slope			
Org. matter	1.5			
pH	5.8			
Practice	Other			
	Crop Rotation			
Year 1	Peppers Bell,	Peperoni pieno campo,	Conventional,	Irr.
Year 2	Cantaloupe,	Meloni pieno campo,	Conventional,	Irr.

Figure 8: Field Information, Farm 2

AZIENDA AGRARIA TRASIMENO 2

FIELD SUMMARY

Field	Acres	Year 1	Year 2
APPEZZAMENTO 1	50	Cantaloupe	Peppers Bell
APPEZZAMENTO 2	30	Cantaloupe	Peppers Bell
APPEZZAMENTO 3	20	Cantaloupe	Peppers Bell
APPEZZAMENTO 4	60	Peppers Bell	Cantaloupe
APPEZZAMENTO 5	15	Peppers Bell	Cantaloupe
APPEZZAMENTO 6	25	Peppers Bell	Cantaloupe

ENVIRONMENTAL SUMMARY

Field	Water Erosion Potential	Pesticide Leaching Potential	Pesticide Runoff Potential	Pesticide Warning Label	Nitrogen Leaching Potential	Phosphorous Runoff Potential	Wind Erosion Potential
APPEZZAMENTO 1	L	HHHHH	HHHHH	HHHHH	-	HHHHH	-
APPEZZAMENTO 2	L	HHHHH	HHHHH	HHHHH	-	HHHHH	-
APPEZZAMENTO 3	HHHHH	HHHHH	HHHHH	HHHHH	-	HHHHH	-
APPEZZAMENTO 4	L	HHHHH	HHHHH	HHHHH	-	HHHHH	-
APPEZZAMENTO 5	HHHHH	HHHHH	HHHHH	HHHHH	-	HHHHH	-
APPEZZAMENTO 6	L	HHHHH	HHHHH	HHHHH	-	HHHHH	-

ECONOMIC SUMMARY

		Average of All Years
ACRES	Crop Acres	200
FINANCIAL	Net farm income	322,786
	Cash surplus or deficit	224,466
	Net worth changed	225,829
FEED BALANCES	Corn equivalents (bu.)	-
	Hay equivalents (ton)	-
	Silage equivalents (ton)	-
	Pasture equiv. (AUM)	-
LABOR	Annual labor hours	4,886
WATER	Inches per irrigated acre	4.3
	Total acre feet	70.8

Figure 9: Plan Summary, Farm 2

4.3. Farm 3 (Azienda agraria Trasimeno 3)

This is a typical traditional farm, based on a rotation between a winter crop, in this case barley, and spring crops like corn and sunflowers. There are no livestock enterprises. Corn produces the highest income of the three crops. Barley is an average income crop. Sunflowers in the past years was a very high income crop but with the reform of the Common European Policy, the price of sunflowers is decreasing every year so that it is changing its status to an average income crop. For the next few years, some subsides will be provided for farmers growing sunflowers to compensate them for the loss of income, but in this application these subsides were not taken into account. In addition, in this case very poor management of resources for this crop caused a very low return over direct expenses.

Farm 3 is comprised of 200 acres with a typical rotation of 100 acres for corn, 50 acres for barley, and 50 acres for sunflowers. No manure is used for fertilizer.

Sunflowers are grown using conventional tillage, some sprinkler irrigation, chemical fertilizers, and pesticides. The yield is 20 cwt per acre, with an expected price of $9.80/cwt. The return over direct expenses is only $8.29 per acre. The corn yield is 160 bushels per acre, using conventional tillage, sprinkler irrigation, and high chemical inputs. The average price per bushel is $4.68. The return over direct expenses is $342.36 per acre. The yield of barley is 72 bushels per acre, and the price per bushel is $4.40. Again, tillage is conventional and chemical fertilizers and pesticides are used. $160.34 per acre is the return over direct expenses. Figure 10 shows the main input technologies used to produce each crop.

CROP	TILLAGE	PESTICIDE	FERTILIZER	IRRIGATION
Corn	Conventional	Lasso MCPA	Urea Ammonium Phosphate Potassium Sulfate	Sprinklers
Barley	Conventional	Bentazon MCPP	Urea Ammonium Phosphate	---
Sunflowers	Conventional	Goal 1.6 E	Urea Ammonium Phosphate	Sprinklers

Figure 10: Main input technologies for Farm 3.

This farm has four fields, and the main characteristics of each field are shown in Figure 11. The economic output shows a relatively good net farm income, considering the kind of crops produced. Environmental output is very good for two fields concerning the potential for water erosion, good for three fields concerning phosphorus runoff potential, and negative for the remaining fields and environmental factors. In particular, the pesticide impact is always high. Even if the farm doesn't use very many kinds of pesticides, the ones it uses have a high potential for negative environmental impacts. Figure 12 shows the field, environmental, and economic summary for Farm 3.

AZIENDA AGRARIA TRASIMENO 3

FIELD NO. 1

Name	APPEZZAMENTO 1
Acres	50
Soil Type	Millsholm Rocky sandy loam, 5-3% slope
Org. matter	0.75
pH	6.45
Practice	Other

Crop Rotation

Year 1	Corn,	120 day,	30" row,	150 bu.,	before Barley,	Conventional
Year 2	Barley,	wint, Med. mgmt,		80 bu.,	Conventional	
Year 3	Corn,	120 day,	30" row,	150 bu.,	Conventional,	Irr.

FIELD NO. 2

Name	APPEZZAMENTO 2
Acres	50
Soil Type	Millsholm clay loam, 0% slope
Org. matter	2
pH	6.45
Practice	Other

Crop Rotation

Year 1	Corn,	120 day,	30" row,	150 bu.,	Conventional,	Irr.
Year 2	Sunflowers,	Girasole irriguo,	Conventional,	Irr.		
Year 3	Corn,	120 day,	30" row,	150 bu.,	Conventional,	Irr.

FIELD NO. 3

Name	APPEZZAMENTO 3
Acres	50
Soil Type	Millsholm Rocky sandy loam, 0% slope
Org. matter	0.75
pH	6.45
Practice	Other

Crop Rotation

Year 1	Barley,	wint, Med. Mgmt,		80 bu.,	Conventional	
Year 2	Corn,	120 day,	30" row,	150 bu.,	Conventional,	Irr.
Year 3	Sunflowers,	Girasole irriguo before Barley,			Conventional,	Irr.

FIELD NO. 4

Name	APPEZZAMENTO 4
Acres	50
Soil Type	Millsholm clay loam, 5-30% slope
Org. matter	2
pH	6.45
Practice	Other

Crop Rotation

Year 1	Sunflowers,	Girasole irriguo,	Conventional,	Irr.	
Year 2	Corn,	120 day,	30" row,	150 bu.,	Conventional
Year 3	Barley,	wint, Med. mgmt,		80 bu.,	Conventional

Figure 11 Field Information, Farm 3

AZIENDA AGRARIA TRASIMENO 3

FIELD SUMMARY

Field	Acres	Year 1	Year 2	Year 3
APPEZZAMENTO 1	50	Corn	Barley, wint.	Corn
APPEZZAMENTO 2	50	Corn	Sunflowers	Corn
APPEZZAMENTO 3	50	Barley, wint.	Corn	Sunflowers
APPEZZAMENTO 4	50	Sunflowers	Corn	Barley, wint.

ENVIRONMENTAL SUMMARY

Field	Water Erosion Potential	Pesticide Leaching Potential	Pesticide Runoff Potential	Pesticide Warning Label	Nitrogen Leaching Potential	Phosphorous Runoff Potential	Wind Erosion Potential
APPEZZAMENTO 1	HHHHH	HHHHH	HHHHH	HHHHH	-	MMM	-
APPEZZAMENTO 2	L	HHHHH	HHHHH	HHHHH	-	MMM	-
APPEZZAMENTO 3	L	HHHHH	HHHHH	HHHHH	-	MMM	-
APPEZZAMENTO 4	HHHHH	HHHHH	HHHHH	HHHHH	-	HHHHH	-

ECONOMIC SUMMARY

		Average of All Years
ACRES	Crop Acres	200
FINANCIAL	Net farm income	26,828
	Cash surplus or deficit	17,756
	Net worth changed	17,911
FEED BALANCES	Corn equivalents (bu.)	-
	Hay equivalents (ton)	-
	Silage equivalents (ton)	-
	Pasture equiv. (AUM)	-
LABOR	Annual labor hours	925
WATER	Inches per irrigated acre	3.1
	Total acre feet	38.8

Figure 12: Plan Summary, Farm 3

4.4. Managing Italian Data with U.S. Software

Since Planetor is a computer program designed for use in the USA, several kinds of problems became apparent when working with Italian data. The main difference is the easurement system. All data for Italian farms are expressed in the metric system so to avoid possible problems with the final output all Italian data were converted to the U.S. system. Also, some adaptations were done with the field operations because some kind of operations or machinery are different in Italy. Obtaining all the data required to edit machinery operations to Italian specifications was not practical, so some field operations were assumed to be similar to the U.S. operations, even though some differences probably exist. Similar problems occurred for a few fertilizers and pesticides, but not for a large number of them. Of course there were also different prices for some resources, such as fuel, which is more expensive in Italy, about $1.42/gal, and the hand labor ($9.00/hr). Therefore, some default prices were changed to reflect Italian prices.

One of the most important problems was to introduce data from the Trasimeno area into the climate data base. Relatively few of the data items needed were available. Temperature, precipitation, and days wet are the data available for the Trasimeno area, the rest of the climate data was taken from the most similar U.S. climate condition found in the data base. For the RUSLE database the Memphis, TN data set was selected and for the NLEAP database the Henry, TN data set was used.

Perhaps the most difficult problem was to find an appropriate soil type for the Trasimeno area from the U.S. soils database. This was mainly due to some differences in the classification systems. The most common group of soils in the Trasimeno area are Xerochrepts, which are also common in California. The California soils database was used for the simulation, with minor adaptations to the data. The slope percent was changed because the part of Trasimeno area in which the farms were located is mostly 0% to 5% slope. It was not always possible to find the right soil type together with the right percent slope in the database.

There are also differences in some farm economic information. In particular, in Italy the nonfarm wages and salary, nonfarm income, and family expenses are not taken into account in the farm economic analysis, so they don't appear in the income statement, cash flow, or net worth. Taxes of course are different. The tax system in Italy is completely different, so it was not possible, at the moment, to put it into the database. Despite all these differences and problems, it was possible to go ahead with the work by accepting some approximations and adaptations, and because the purpose of the study was not to get the absolute answer on the sustainability of these three Italian farms, but to try and understand how Planetor works with Italian data and what should be done to develop a working Italian version of Planetor.

5. Can the Planetor Program be Adapted to Work for Italian Farms?

Taking into account the discussion in the previous section, it is understandable that using Planetor as it currently exists would not be useful for evaluating the sustainability of Italian farms. There would be too many approximations, which would make the final output very weak.

However, the current version of Planetor even with these constraints is better than the first version of the program (Planetor 1) for use in Italy. Planetor 2 is a better starting point than Planetor 1 to develop an Italian version. One of the most important improvements is the use of individual crop budgets which can be built into rotations, rather than requiring a rotational budget. This will reduce the number of typical budgets needed, and will also reduce developmental resources required before the program can be implemented. In addition, the availability of typical crop budgets instead of rotational budgets results in less constraints when working with Planetor.

What needs to be changed to get an Italian version of the program? Several things do need to be changed, but the general framework of the program doesn't need significant modifications which presents a very real opportunity to adapt the program for Italy. The major changes have to be made in the database part of the program. There are only two important modifications to make in the computational interface part of the program. First is the measurement system. This is a large change, because it involves many parts, but it is also reasonably easy to accomplish. The second major general change would be, of course, the translation into Italian, which is also a big, but relatively easy modification. Some other minor changes would be required in the working part and in the general framework of the program, for example, some adjustments in the economic input requirements and in the presentation of the economic outputs would be necessary.

The biggest adaptation challenge is restructuring and obtaining appropriate data for the database portion of Planetor. The changes necessary to adapt each Planetor database will be discussed in the following sections.

Crop information

There are some very common Italian crops which should be added to the crop list. But the main concern is whether the RUSLE crop growth data stored for two week intervals during the growing season needs to be edited for Italian conditions. If this crop growth data requires adaptation, it would require significant effort to produce the required data. A similar situation exists for the NLEAP crop data, but this data should be more readily available if changes are required.

Livestock information

This part of the database requires few changes. All data required to complete the necessary changes are currently available. The livestock list would need some additions as there are a few different breeding systems in Italy.

Soil information

This is probably the biggest area of concern for developing an Italian version of Planetor. First of all, in Italy it is very common to have several different soil types in a field; but this is a more general problem, which at the moment is not solved even in the U.S. version. The most important issue is that the Italian soils database does not include some important required data, at least for some areas of Italy. At a local level, many efforts are being undertaken to improve the soils database in some regions of Italy, but in other regions there is a lot of work left to do.

Pesticide information

This should be an easy part to adapt to the Italian situation. The pesticide list needs a few changes due to the different commercial names. A few pesticides need to be added to the list, but the pesticide properties data are readily available. The application method list is quite easy to adapt.

Fertilizer information

The fertilizer database is also easy to adapt. Some fertilizers need to be added to the list. The application method list, again, is easy to adapt.

Machinery information

Some modifications should be made in the machinery list because of different technical characteristics. For most of the field operations the data for repair costs, diesel use, and even machine hours would have to be changed, but basically this data is available. The physical effect of machinery operations would not have to be changed.

Manure information

The required data for manure is available. Both the storage systems and the application method lists would be easy to adapt. Here also, as for the field operations, some changes would be required for repair costs, diesel use, and machine hours.

Irrigation information

This is a very simple database. The only data required is the irrigation system list, which is very similar in Italy and, of course, the data is available.

Climate information

This is a database which would need to be entirely changed. Fortunately, in Italy there are less climatic differences than in the U.S., so the effort to build the new database should be less difficult even though it is a demanding task. In Italy there is a good tradition of meteorology and climatology, and scientists have been collecting data for many years. For most regions of Italy, data for both the RUSLE and NLEAP databases should be readily available. There could be some problems for some areas.

Tax information

Of course the tax information is not relevant for Italy. The tax information section has to be adapted to the Italian farm tax system, which is very different from the U.S. system. The value added tax should be included, and this is quite complicated. The income and the real estate taxes would also have to be included.

After this closer examination of the changes needed to convert the Planetor program, it is easier to briefly summarize the major problems to be solved before attempting to develop an Italian version of Planetor.

There is a need for many different kinds of data to be gathered. Some of this data is already available, such as required for pesticide, fertilizer, machinery, manure, etc. Of course they would need to be organized for use in Planetor.

Climate data should also be readily available, but this needs to be verified due to the high number and types of data items required.

Crop data already available needs to be organized, and additional crop data needs to be obtained through literature searches or research.

Finally, the soils database is the biggest challenge for an Italian version of Planetor. Even if significant data about Italian soils is already available, this data needs to be organized, revised, and standardized, since different areas have used different soil classification systems. Furthermore, frequently not all the data required in Planetor are available, at least not in certain areas of Italy.

As a result, the answer to the question "Can the Planetor program be adapted to work for Italian farms?" is a qualified yes. The conversion would be possible, because we are not speaking about two extremely different worlds, but it would take a long time, and the costs would definitely be high. The first step should be to verify what data is available, what data needs to be improved, and what needs to be collected. This alone would be a long process. The second step would be to translate the program to Italian, convert the measurement units, and put the Italian data into the database. The third step would be testing the program using sample farms. Finally, there should be a good training program developed first for the extension service and then for farmers. The data management and training costs contribute dramatically to raise the total cost of this project.

Italian agriculture and the environment are so diversified that, even though it is not a large country, it might be very difficult to work on a general Italian version. Probably the best way to reduce the time and maybe the cost would be to include Planetor for Italy in a national framework project, but to work at a local level achieving first a regional version of Planetor. This would improve the chances for successfully developing an Italian version of Planetor.

6. Conclusions

This feasibility analysis of an Italian version of Planetor from the technical perspective has showed that, even if the time and financial costs would be high, the conversion is something that could be accomplished. But what about the political situation? In other words, is there sufficient interest in such a project both at a local and national government level?

The interest for sustainable agriculture is currently very high in Italy. However, in the past too many people spoke about sustainable agriculture with too few concrete actions resulting from such discussions. This is an excellent time to present a project which is not only research oriented but also practical. This is an especially good time due to the 2078/92 and 2080/92 EU Regulations, which are just being implemented. In the next several years the Extension Services will need tools for monitoring and managing new ways to work with farms. In the meantime, the Italian central government and regional governments need a way to control the production practices on farms which will receive subsidies for a more sustainable agriculture. So, there will be the need at different levels to check the economic and the environmental results of farms. Planetor could be the appropriate tool for this task. An Italian version of the program could be immediately useful and operative.

Maybe in the future the economic science will provide means to include in the economic balance the environmental impact, so that sustainability will be measured in monetary terms and will be part of the economic and financial results of a farm. At present this is not possible, but we do need to measure sustainability. This is the purpose of Planetor.

We need to separate what must remain in the research arena at the moment, and what is actually available to help farmers achieve sustainable agriculture.

"Achievement of sustainable development will require that effective bridges be built between the "island empires" of agriculture, environment, health research, and policy. The central role of communities, firms, and families in achieving growth of agricultural production, improvement in health, and enhancement of the resource base will require more effective working relationships among suppliers of knowledge and between suppliers and users" (V.W.Ruttan, 1994). Planetor is a good example of a beneficial way to cooperate between research and the operative world.

REFERENCES

Center for Farm Financial Management, "Planetor 2.0". Software rel. 0.65. Minnesota Extension Service, University of Minnesota, 1994.

Ciani, A., Boggia, A., "The EEC Agro-Environmental Program: a Challenge for Sustainable Development Towards XXI Century". Paper presented to 3rd International Meeting of The International Society for Ecological Economics. S. Jose', Costa Rica, October 24-28, 1994.

Crop Protection Chemicals Handbook. 1994. 10th Edition. Chemical and Pharmaceutical Publishing Corp. New York, NY. 1948 pages.

Fuller, E., B. Lazarus, L. Carrigan, G. Green. 1992. Minnesota Farm Machinery Economic Cost Estimates for 1992. Minnesota Extension Service AG-FO-2308-C. 6 pages.

Hornsby, Arthur G., 1992. Site Specific Pesticide Recommendations: The Final Step in Environmental Impact Prevention. Weed Technology, Vol. 6:736-742.

Keeney, D., "Sustainable Agriculture: Definition and Concepts". Journal of Production Agriculture. Vol.3, no.3, July-September 1990.

Lemunyon, J.L., R.G. Gilbert. 1993. The Concept and Need for a Phosphorus Assessment Tool. J. Prod. Agric. 6:483-486.

Pearce, D.W., Barbier E., Markandya A., "Sustainable Development and Cost Benefit Analysis". IIED/UCL London Environmental Economics Centre Paper 88-03, 1988.

Pearce, D.W., Turner R.K., "Economics of Natural Resources and the Environment". Harvester Wheatsheaf, London, 1990.

Pearce, D.W., "Blueprint 2: Greening the World Economy". Earthscan, London, 1991.

Renard, K.G., G.R. Foster, D.K. McCool, G.A. Weesies, D.C. Yoder. 1993. RUSLE User's Guide. Soil and Water Conservation Society. Ankeny, Iowa. 102 pages.

Ruttan, V.W., "Sustainability is not enough", in C.K.Eicher, J.M.Staatz, Agricultural Development in the Third World, The John Hopkins University Press, Baltimore 1990.

Ruttan, V.W., "Sustainable Growth in Agricultural Production: Poetry, Policy and Science", in Agricultural Sustainability, Growth, and Poverty Alleviation: Issues and Policies, Feldafing, Federal Republic of Germany, September 23-27, 1991.

Ruttan, V.W., "Global Research Systems for Sustainable Development: Agriculture, Health, and Environment". Choices. Third Quarter, 1994.

TAC/CGIAR, "Sustainable Agricultural Production: Implications for International Research". FAO, Rome 1989.

USDA, "Sustainable Agriculture Research and Education Program", Brochure USDA/CSRS/SARE, February 1994.

Wauchope, R.D., T.M. Butler, A.G. Hornsby, P.W.M. Augustign-Beckers, and J.P. Burt. 1992. The SCS/ARS/CES pesticide properties database: Select values for environmental decision making. Rev. Environ. Contam. Toxicol. 23:1-164.

WCED,"Our Common Future.(The Bruntland Report)". Oxford University Press, 1987.

Appendix: Planetor Databases

Crops Database Items

Crop name
Weight in pounds of one unit
Feed equivalent type: Corn, Hay, Silage, Pasture
Feed equivalent conversion factor
Moisture depletion rate
Moisture content of harvested portion
C:N ratio of unharvested portion
C:N ratio harvested portion
Percent of growing season - initial stage of crop growth
Percent of growing season - developmental stage of crop growth
Percent of growing season - reprodutive stage of crop growth
Percent of growing season - maturation stage of crop growth
Crop coefficient initial stage of crop growth
Crop coefficient reproductive stage of crop growth
Crop coefficient maturation stage of crop growth
N uptake - pounds per harvest unit
Legume crop: Yes/No
Crop type: annual crop, perennial crop, winter crop
Growing season number of days for winter crops
Temperature below which crop is inactive
Over winter transpiration coefficient
Root biomass ratio to above ground biomass
Maximum root depth
Row crop: Yes/No
Nonharvested yield after last cutting for forages
Fragile or nonfragile residue
Yield/Residue ratio
Row spacing
Plant population
Surface residue decomposition constant
Sub-surface residue decomposition constant
Residue weight at 30% cover
Residue weight at 60% cover
Residue weight at 90% cover
Root mass (lb/A) in top 4" of soil for each two week interval of the growing season
Fall heigth from crop canopy in feet for each two week interval of the growing season
Percent canopy cover for the crop for each two week interval of the growing season

Livestock Database Items

Livestock Name
Breeding or finishing enterprise
Production Unit; head, litter, etc.
Breeding Female Unit; cow, sow, etc.
Number of months covered by the budget
Type of product produced; offspring, nonstorable product, storable product
Purchase unit; head, lbs, cwt
Sales unit; head, lbs, cwt, other
Months offspring on farm
Manure C:N Ratio
Manure density, lbs/cu. ft
Manure water percent
Breeding animal cubic feet manure produced per day
Breeding animal pounds of N produced per day
Breeding animal pounds of P produced per day
Breeding animal pounds of K produced per day
Finishing animals cubic feet manure produced per day
Finishing animals pounds of N produced per day
Finishing animals pounds of P produced per day
Finishing animals pounds of K produced per day

Soils Database Items

State FIPS code
Soil survey area id
Soil survey area name
County FIPS code
County name
MUID - symbol displayed on soil maps
Soil name
Soil description
K fine factor
K factor
Slope percent low value
Slope percent high value
Slope percent average
Length of slope
T factor
Surface texture
Hydrologic group
Minimum distance to water table

Soils Database Items (continued)

Maximum distance to water table
Depth of top layer (inches)
Rock zone depth (inches)
Depth to hard pan (inches)
Salinity layer 1
Salinity layer 2
Bulk density layer 1
Bulk density layer 2
Permeability layer 1
Permeability layer 2 to 5 feet
Permeability of least permeable layer
Water holding capacity layer 1
Water holding capacity layer 2
pH layer 1 low value
pH layer 1 high value
pH layer 1 average
pH layer 2 average
Percent of fragments > 3 inches layer 1
Percent passing seive number 10 layer 1
Coarse fragments percent layer 1
Percent of fragments > 3 inches layer 2
Percent passing seive number 10 layer 2
Coarse fragments percent layer 2
Percent clay actual top layer
Percent clay layer 1
Percent clay layer 2
Percent organic matter surface layer 1 low value
Percent organic matter surface layer 1 high value
Percent organic matter layer 1 average
Percent organic matter layer 2 average
Water content at 15 bar layer 1
Water content at 15 bar layer 2
Depth of profile
Cation exchange capacity
Drainage class
Soil pesticide leaching rating
Soil pesticide runoff rating
Wind erodibility group
Wind erodibility index
Type of water table

Pesticide Database Items

Common name
Recognized trade name
Label toxicity
Dry or wet formulation
Amount of active ingredient
Koc - organic carbon sorption coefficient
pH level at which Koc was determined if pH dependent
Half life in days
Health Advisory Level
Lc50 - aquatic toxicity

Fertilizer Database Items

Fertilizer name
Unit (lb, ton, etc.)
Pounds of N per unit
Pounds of P per unit
Pounds of K per unit
Ratio of NO3-N
Ratio of NH4-N

Machinery Operations Database Items

Name of machinery operation
Gallons of diesel fuel per acre
Repairs cost per acre
Hours full time labor per acre
Hours seasonal labor per acre
Calculate residue by cover or weight?
Percent soil disturbance
Initial roughness factor
Final roughness factor
Percent cover left, nonfragile residue
Percent cover left, fragile residue
Depth of disturbance (inches)

Machinery Operations Database Items (continued)

Effects of operation
- Soil surface disturbed?
- Crop residue added to surface?
- Other residue added?
- Residue removed?
- Crop harvested?
- Crop growth begins?
- Crop is killed?
- Start new crop growth?

Percent residue removed, if any

Climate Database Items

State
County
Station site
EI curve number
Number frost days / year
Altitude
EI of 10 year peak storm
R factor
R equivalent for NW U.S.
monthly average precipation amounts
Monthly average temperature
Biweekly EI sum
EI distribution throughout year
Monthly number of days wet
Monthly pan evaporation amounts
Monthly pan coefficients

Manure Application Methods Database

Application method name
Percent N loss from application in < 7 days
Percent N loss from application in > 7 days
Phosphorus runoff potential
Gallons of diesel fuel per acre
Repairs cost per acre
Hours full time labor per acre
Calculate residue by cover or weight?
Percent soil disturbance
Manure Application Methods Database (continued)

Initial roughness factor
Final roughness factor
Percent cover left, nonfragile residue
Percent cover left, fragile residue
Depth of disturbance (inches)
Effects of operation
- Soil surface disturbed?
- Crop residue added to surface?
- Other residue added?
- Residue removed?
- Crop harvested?
- Crop growth begins?
- Crop is killed?
- Start new crop growth?

Percent operation added residue
Surface residue decomposition constant
Sub-surface residue decomposition constant
Residue weight at 30% cover
Residue weight at 60% cover
Residue weight at 90% cover